PATENT COOPERATION TREATY

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17 JUN 2005

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

To:

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PATENTANWÄLTE
10. Juni 2005

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing *(day/month/year)*	10.06.2005
Applicant's or agent's file reference O 1 P 99 wo	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP 03/14226	15.12.2003	20.12.2002

Applicant
OUTOKUMPU OYJ et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed invention is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international preliminary examining authority:

European Patent Office - P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk - Paye Bas
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Form PCT/IPEA/416 (January 2004)

PATENT COOPERATION TREATY

PCT

17 JUN 2005

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

REC'D 15 JUN 2005
WIPO PCT

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
O 1 P 99 wo		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP 03/14226	15.12.2003	20.12.2002
International Patent Classification (IPC) or both national classification and IPC		
B01J8/18		
Applicant		
OUTOKUMPU OYJ et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 6 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
25.06.2004	10.06.2005
Name and mailing address of the international preliminary examining authority:	Authorized Officer
European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Lapeyrere, J Telephone No. +31 70 340-2333

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP 03/14226

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1, 4, 5, 8-16	as originally filed
2, 2a, 3, 3a, 6, 7	received on 01.10.2004 with letter of 29.09.2004

Claims, Numbers

1-17	received on 01.10.2004 with letter of 29.09.2004

Drawings, Sheets

1/4-4/4	as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-17
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-17
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-17
	No:	Claims	

2. Citations and explanations

   see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following document:
   D1: US 5 226 374

2. Amendments brought in letter in date of 29 September 2004 have been examined and are considered as fullfilling requirements of article 34(2)(b) PCT.

3. Document D1, which is considered to represent the most relevant state of the art, discloses a method of controlling the process conditions from which the subject-matter of claim 1 differs in that "the material quantity of the material fed to the reactor is determined by measuring the pressure and/or the pressure loss in a conveying line upstream of the reactor in particular in an airlift."
   In document D1 the quantity of material is determined by a photoelectric cell.

4. The subject-matter of claim 1 is therefore novel (Article 33(2) PCT).

5. The problem to be solved by the present invention may therefore be regarded as providing an alternative to the current control method.

6. The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:
   First no other document discloses a method of control by pressure. Moreover it could be possible for the man skilled in the art to think to replace the photocell measurment by a pressure measurment in the the method of control. This would imply to replace also the feed by gravitation by an airlift. This is not considered as obvious for the man skilled in the art.

7. Claims 2 to 10 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

8. With the same reasoning subject-matter of independent apparatus claim 11 is

considered as being new (Article 33(2) PCT) and involving an inventive activity (Article 33(3) PCT)

9. Claims 12 to 17 are dependent on claim 11 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

Furthermore, a temperature control with manipulating intervention in the fuel feed is known. This form of control is superior in control quality to the control of the mass flow of the raw material charge, as can be seen from Fig. 2. The same disturbance in the material feed to the reactor is compensated for by a change in the fuel mass flow (fuel feed) and leads to the reactor temperature already assuming the desired set point again substantially quicker.

The US 5,226,374 discloses a method of controlling combustion in a fluidized-bed incinerator comprising measuring a supply rate of incineration waste. When the supply rate of incineration waste is higher than a predetermined value, the supply rate of the incineration waste of the dust feeder is decreased to suppress a combusting operation. Further, i.e. an induced gas rate of an exhaust gas induced blower of the incinerator is increased to suppress an increase in an incinerator internal pressure. The supply rate of incineration waste is measured by a measuring unit using a photoelectric element arranged on a shoot for supplying incineration waste.

The JP 55140008 (Patent Abstracts of Japan) describes a high accuracy control of temperature by measuring the temperature in the fluidized-bed and controlling the amount of floating medium forming the fluidized-bed in order to adjust the temperature.

In the EP 0 093 063 A1 a temperature control of a fluidized-bed reactor is described measuring the temperature in the fluidized-bed of the reactor and varying the temperature of the material transported into the reactor by mixing up material out of two conduits with higher and lower temperature. A similar method is employed in the WO 96/18076 A1 describing a gas cooler having a circulating fluidized-bed. Hot gas is introduced into a mixing chamber where it is mixed with solids having a temperature lower than that of the gas, whereby the temperature

of the mixing chamber settles to a mixing temperature. The mixture of the gas and solids is taken from the mixing chamber via a riser to a solids separator, thereby regulating the temperature of a superheated steam generated in connection with the gas cooling.

All of these controls therefore have the disadvantage that a control deviation (temperature deviation) first has to be discovered in the reactor before the energy input can be correspondingly adapted and the control deviation corrected as a result. A further disadvantage is the strong dead-time behaviour of such reactor systems (big masses of brick lining and high product inventory). In some processes, however, even just brief temperature fluctuations lead to losses in the product quality.

Description of the invention

Object of the present invention, therefore, is to control the process conditions, in particular the temperature, in a reactor as constantly as possible to a set point predetermined in relation to the process.

In a method of the type mentioned at the beginning for controlling e.g. the temperature, this object is essentially achieved in that the material quantity transported in the conveying line is determined and is used as control variable and/or disturbance variable for controlling the process conditions, in particular the temperature. This has hitherto not been conventional practice in the case of granular material, because the determination of the material quantity in a conveying line in the case of granular material is very complicated. However, by virtue of the fact that, according to the invention, the material quantity fed to the reactor

is determined in advance, namely in a conveying line to the reactor, and this variable is used directly as control variable and/or disturbance variable for the control, possible fluctuations in the reactor temperature become apparent in advance and can be corrected before a change in the temperature or other process conditions occurs due to the changed material quantity entering the reactor. The method of controlling the temperature in a reactor, according to the invention, is thus also quite generally a method of producing constant process conditions in a reactor, in particular in order to keep the temperature in and/or the material feed to a reactor (material charge introduced into a reactor) of a plant constant. The determination of the material quantity of the material introduced into the reactor consists in the measurement of the pressure and/or of the pressure loss in the conveying line upstream of the reactor. Such a conveying line may in particular be an airlift, with which material is conveyed upwards. The measurement of the pressure or of the differential pressure between start and end of the conveying line of the airlift allows the amount of material which is transported to be accurately deduced. According to the invention, it has been found that this method can be used very accurately even in the case of granular material without recourse to density measuring with radioactive material for example.

To this end, according to a practical refinement of the idea according to the invention, the material quantity in the conveying line can be controlled to a predeterminable value. In this case, the material quantity is a control variable of the control. The method according to the invention therefore constitutes a control of the material charge introduced into a plant having a reactor in which the material in particular is heated, the material being introduced into the plant via a conveyor for example and being transported by a conveying line directly or via intermediate stages to the reactor, the material quantity in the conveying line being determined and being controlled to a predeterminable value. As a result, the material quantity introduced into the reactor is kept essentially constant, so that, in

the reactor, fluctuations in the material quantity which may cause a temperature difference and/or a change in the stoichiometry do not occur or are minimized.

The material quantity in the conveying line, in a simple manner, can be controlled by a conveyor, with which the material is introduced into the plant, in particular by varying the rotational speed of a material-charging screw and/or by a weighfeeder (proportional weigher belt) upstream of the material-charging screw. This control eliminates the production-reducing effect of temporary deposits of the material-charging screw for the case where no weighfeeder is pre-

be taken into account in the control of the heat supply. In particular if the material is already (pre)-dried when the material quantity is determined, the short dead time until the material is actually introduced into the reactor can be taken into account especially accurately on account of the constant process conditions.

A possible material discharge between the determination of the material quantity and the feeding of the material into the reactor is preferably also determined if need be and is taken into account during the control, in particular of the material feed and/or of the heat supply. Such a material discharge may be, for example, a reactor bypass in which material is branched off before the feeding into the reactor and is mixed again with material treated in the reactor after this material treated in the reactor has been discharged. Such a bypass mass flow must be deducted, for example, when determining the heat or fuel requirement.

In order to reduce disturbing effects when determining the material quantity, in particular due to residual moisture of the raw material introduced, and in order to eliminate the effect of the material moisture during the delivery of the material into the plant, the material may advantageously be dried and/or preheated before the determination of the material quantity in the conveying line. In particular, constant measuring conditions then prevail, so that the effects of the material introduced into the reactor on the temperature prevailing in the reactor can be accurately estimated and taken into account by the control.

This control can be used in a multiplicity of reactor types. According to special refinement of the method according to the invention, a gas/solid suspension can form in the reactor, for example as a circulating fluidized bed. In these reactor types, for certain processes, for example calcination, it has proved to be especially important and advantageous that the reactor temperature can be accurately maintained within marginal fluctuations. The methods described above may be used, for example, for the temperature control of a reactor having a circulating fluidized bed during alumina calcination. In particular moist hydrate, for example, can be introduced as raw material into the plant.

The present invention also relates to a plant for the heat treatment of material fed to a reactor, in particular for carrying out the method described above. The plant has a conveying line for the transport of granular material to the reactor and at least one control. According to the invention, the control is connected to a measuring device for determining the material quantity of the granular, in particular fine-grained, material transported in the conveying line to the reactor. As a result, the disturbance variables of a fluctuating material delivery and moisture can be taken into account by the plant control in order to correct the process conditions in advance, in particular the reactor temperature and the material charge introduced into the reactor, and thereby keep the said process conditions constant.The conveying line is a fluid-pressure conveying line, in particular a preferably perpendicularly arranged rising line of an airlift. It has been found that, in contrast to conventional methods of determining the quantity of fine-grained material which is transported in a conveying line, the